ORTEC®

Model 921E
EtherNIM™ High-Rate Multichannel Buffer

Hardware Manual

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Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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TABLE OF CONTENTS

WARRANTY ii

Safety Instructions and Symbols iv

Safety Warnings and Cleaning Instructions v

1. INTRODUCTION 1
   1.1. About This Manual 1

2. INSTALLATION 3
   2.1. Ethernet Connection (Not Supported by Vista) 4
   2.2. Cabling Up a System 4

3. TROUBLESHOOTING 7
   3.1. Data or Settings Are Lost When Power Is Turned Off 7

4. SPECIFICATIONS 9
   4.1. Front-Panel Indicators 9
   4.2. Connectors 9
   4.3. Data Memory 9
   4.4. Presets 9
   4.5. Interface Connectors (Rear-Panel) 10
   4.6. ADC 10
   4.7. Controls (Front-Panel) 11
   4.8. Digital Spectrum Stabilizer 11
   4.9. Electrical and Mechanical 11
   4.10. Battery Backup 12
   4.11. Feature Mask Bits 12

APPENDIX A. FIRMWARE COMMANDS AND RESPONSES 15
   A.1. CONNECTIONS-32 15
   A.2. Command Records 15
   A.3. Percent Response Records 16
   A.4. Dollar Response Records 19
   A.5. Command Catalog 19

APPENDIX B. DIGITAL SPECTRUM STABILIZATION 55
   B.1. Point Mode Stabilization 55
   B.2. Gauss Mode Correction 55

Safety Instructions and Symbols

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

In addition, the following symbols may appear on the product:

DANGER–High Voltage!

ATTENTION–Refer to Manual

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

Safety Warnings and Cleaning Instructions

DANGER	Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources before opening it.

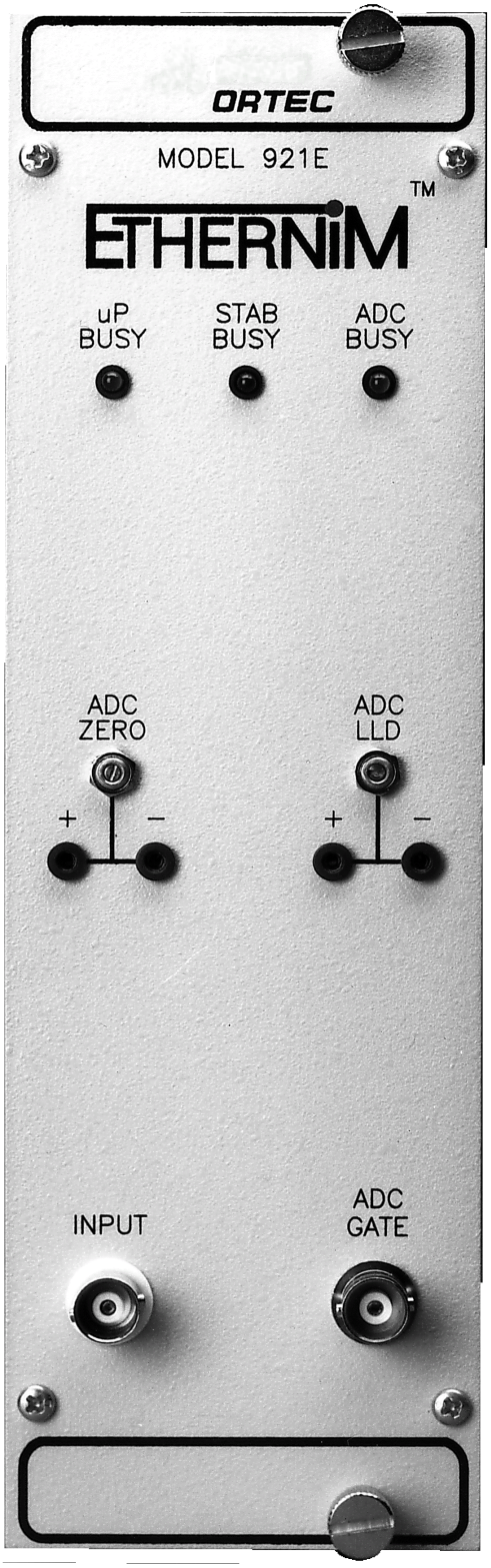
WARNING	Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

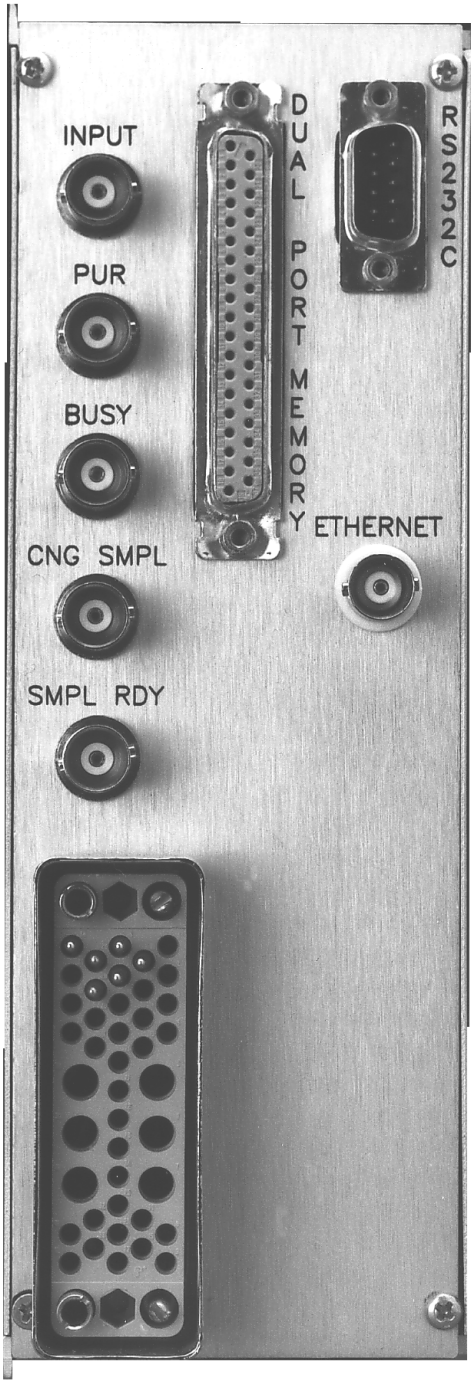
Cleaning Instructions

To clean the instrument exterior:

- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

CAUTION	To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.


ORTEC
MODEL 921E
ETHERNiM
uP BUSY
STAB BUSY
ADC BUSY
ADC ZERO
ADC LLD
INPUT
ADC GATE


INPUT
PUR
BUSY
CNG SMPL
SMPL RDY
DUAL PORT MEMORY
RS232C
ETHERNET

1. INTRODUCTION

The ORTEC Model 921E EtherNIM™ High-Rate Multichannel Buffer (MCB) is a two-wide NIM module designed for high-rate and high-performance data acquisition in nuclear spectroscopy applications. It offers the following functions:

- **Digital Spectrum Stabilizer** Ensures spectral stability over long counting periods and wide ranges of count rate and temperature.

- **Analog-to-Digital Circuit (ADC)** High-speed, 16k-channel, successive-approximation type with a conversion time of 1.5 μs at a rate of 100,000 counts/sec, measured at a 5-μs shaping time with a Model 973 High-Rate Spectroscopy Amplifier.

- **Data Memory** The architecture of the Model 921E employs an 80386 microprocessor with dual Direct Memory Access (DMA) channels to maximize system throughput. In data memory, 1 bit is reserved for a region-of-interest (ROI) flag, leaving a net nonvolatile data memory of 64,000 channels and $2^{31}-1$ (over 2 billion) counts per channel.

- **I/O Port** TTL IN/TTL OUT primarily intended to facilitate interfacing to sample changers.

The Model 921E can be controlled with the accompanying MAESTRO®-32 MCA Emulation Software or other ORTEC CONNECTIONS-32 compatible software packages. In addition, custom control software can be developed with our CONNECTIONS-32 Programmers' Toolkit (A11-B32).

The Model 921E occupies two slots of a NIM-standard bin and can be connected to the host PC via the ORTEC Dual-Port Memory Interface or the legacy Ethernet interface. We recommend using the ORTEC DPM-USB converter interface, which connects the 921E's Dual-Port Memory port to the PC's high-speed USB port. Use an ac-powered USB hub to connect up to eight (8) 921Es as you wish (one USB-DPM per 921E) to a single PC.

Note that Microsoft® Windows® Vista™ does not support the 921E Ethernet interface.

1.1. About This Manual

This manual provides the information you will need to install and configure the Model 921E hardware. For instructions on operating the 921E with ORTEC software applications, refer to the software user manual.

- Chapter 2 tells how to install the software and hardware.
- Chapter 3 provides troubleshooting information.
- Chapter 4 lists the hardware specifications.

- The appendix of firmware commands and responses is intended for users who wish to write custom software to control the Model 921E.

2. INSTALLATION

Do not connect the 921E to the PC until MAESTRO-32 has been installed.

1. Install the accompanying version of MAESTRO-32 (and the CONNECTIONS-32 Update Kit, if included) according to its instructions. Depending on the 921E-to-PC interface(s) you will use, mark the appropriate checkbox(es) on the installation wizard's Instrument Family page as follows:

   - If using a DPM-USB interface converter to attach the 921E to the PC, mark the **DPM-USB** checkbox.

   - If using only the Ethernet interface (and no ORTEC instruments with other types of interfaces are connected to your PC), no selection is required in the installation wizard.

2. Turn off the bin power supply and install the Model 921E in the bin.

3. Cable the spectroscopy system components together.

   - **DPM-USB interface** — Attach the DPM-USB converter's 37-pin connector to the rear panel of the 921E.

   - **Ethernet interface** — If connecting via Ethernet, see Section 2.1.

4. Turn on the bin power. The μP Busy LED on the front panel of the Model 921E should light brightly for a few seconds and then go out.

5. Connect the powered-on 921E to the system:

   - **DPM-USB interface** — Connect to PC's USB port or to an ac-powered hub hosted by the PC. The Windows "found new hardware" wizard will open. Follow the prompts, choosing to (a) *not go to the Internet or the Microsoft website* to find the driver, and (b) *automatically* locate the driver. If the wizard cannot locate the driver, direct it to **C:\Program Files\Common Files\ORTEC Shared\UMCBI**.

   - **Ethernet interface** — Connect to either the PC's LAN card or to a powered Ethernet hub. This connection method does not open a Windows "found new hardware" wizard.

6. Run the MCB Configuration program to build the list of available detectors, according to the MAESTRO *User's Manual*.

   DPM-USB users note: The 921E/DPM-USB combination you have just created is treated as a distinct entity by MCB Configuration. If you disconnect this 921E from the system, then

reconnect via a different DPM-USB converter, you will have to re-run the MCB Configuration program to reestablish communication between the 921E's inputs and ORTEC CONNECTIONS-32 software applications.

7. You are now ready to start MAESTRO-32 and use its **Acquire/MCB Properties...** dialog and the 921E's front-panel controls to set the data acquisition parameters for each input.

2.1. Ethernet Connection (Not Supported by Vista)

This option requires a PC running under Windows 2000 Professional SP4 or Windows XP Professional SP2 or higher, and any Ethernet card that supports 10BASE2.

- Referring to the accompanying *ORTEC MCB CONNECTIONS-32 Hardware Property Dialogs Manual* (P/N 931001, supplied either as hardcopy or in the **\Manuals** folder on the installation disk), set the PC's network protocol to IPX/SPX Compatible.

- Connect the Model 921E to the rear-panel ETHERNET connector using 50 Ω coaxial cable. Be certain that a BNC T-connector and 50 Ω terminator are at each end of the cable.

- Power on the 921E.

- To control multiple 921Es from a single PC via the Ethernet interface, simply chain all 921Es together into a single LAN using BNC T-connectors at each 921E. (Don't forget the 50 Ω terminator required at the last 921E in the chain and at the PC.) The MCB Configuration program handles all the details of identifying each detector, and allows you the option of modifying each one's identification string.

2.2. Cabling Up a System

The standard cabling of a Model 921E system is shown in Fig. 1. If you have a detector that uses a transistor-reset preamplifier (TRP) — that is, a "-Plus" model — all connections shown should be made.

If using a resistive-feedback preamplifier (that is, a detector *without* a "-Plus" model designation), the 132 INHIBIT GENERATOR does not exist, so do not make the connection to TRP INH.

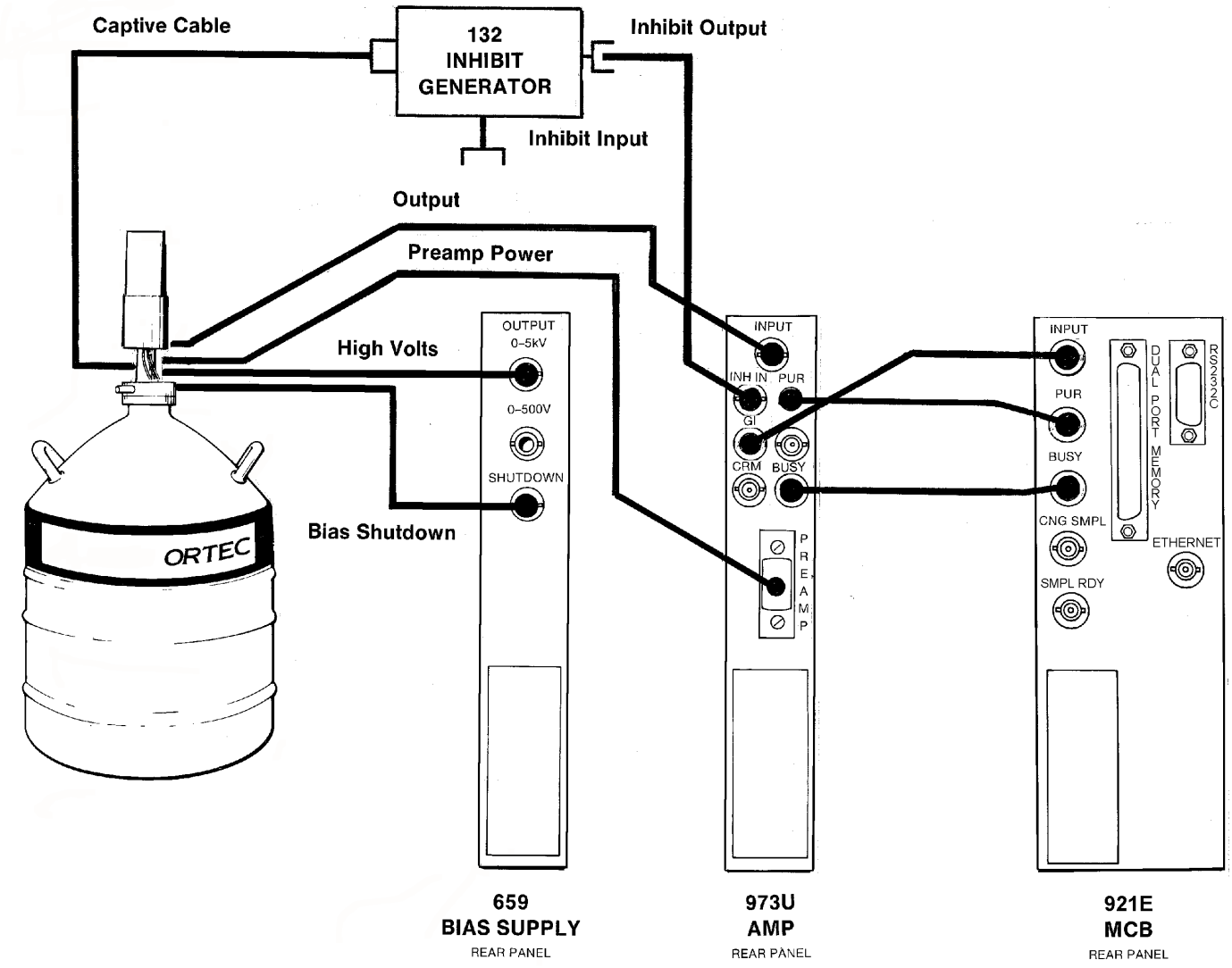


Figure 1. MERCURY (Models 973U/921E) System Interconnections.

3. TROUBLESHOOTING

3.1. Data or Settings Are Lost When Power Is Turned Off

The memory in the Model 921E has battery backup to maintain data when power is removed from the module. It uses a lithium battery with a nominal voltage of 3.6 V specified in Section 4.10.

To test the battery voltage, remove the left side panel (as viewed from the front). The voltage can be measured at the battery cable connector near the top rear of the printed wiring board (PWB). The voltage measured between the outer two pins of the 3-pin connector should be >2 V. If <2 V, the battery needs be replaced to maintain battery back-up.

To replace the battery, locate the battery behind the top of the front panel. Twist or pry it loose from the hook-and-loop fastener strip and unplug the wire connector. Replace with the new battery (placing a strip of paper temporarily between the battery and the hook-and-loop fastener strip may help in positioning the battery).

4. SPECIFICATIONS

4.1. Front-Panel Indicators

µP BUSY Red, busy-rate LED; intensity indicates the relative activity of the microprocessor.

STAB BUSY Red LED indicates when the stabilizer is active.

ADC BUSY Red, busy-rate LED flashes once for each pulse digitized by the ADC.

4.2. Connectors

INPUT Accepts positive-unipolar, positive-gated-integrator, or positive-leading-bipolar analog pulses in the dynamic range from 0 to +10 V with a +12 V maximum; semi-Gaussian-shaped or gated-integrator-shaped time constants from 0.25 to 30 µs, or delay-line-shaped with width >0.25 µs. Z_{in} >1 kΩ, dc-coupled. No internal delay. BNC connectors on front and rear panels.

ADC GATE Optional, slow-positive NIM input. Computer-selectable coincidence or anti-coincidence. Signal must occur prior to and extend 0.5 µs beyond peak detect. Front-panel BNC connector. The ADC GATE has no effect on the live-time correction circuitry.

PUR (Pileup Rejector) Rear-panel BNC connector accepts slow-positive NIM signal. Signal must occur before ADC peak detect. Z_{in} >1 kΩ.

BUSY Busy input used by live-time correction circuits. Accepts slow-positive NIM signal, Z_{in} >1 kΩ. BNC connector on rear panel.

CNG SMPL (Change Sample) TTL output signal, software addressable on rear-panel BNC.

SMPL RDY (Sample Ready) TTL input signal, software readable on rear-panel BNC.

4.3. Data Memory

16k channels of nonvolatile data memory; 2^{31}–1 (over 2 billion) counts per channel.

4.4. Presets

Real Time/Live Time Selectable in multiples of 20 ms.

Region-of-Interest Peak Peak count.

Region-of-Interest Integral Integral count selectable to a maximum value of 2^{32}–1 (over 4 billion).

Data Overflow Terminates acquisition when data in any channel exceeds 2^{31}–1 (over 2 billion) counts.

Statistical Allows setting the required statistical accuracy on a key peak (for example, stop counting when the activity of ^{60}Co is known to be better than 5%).

MDA Stops data collection when the value of the minimum detectable activity (MDA) for a user-specified MDA nuclide reaches the needed value. The MDA preset is implemented in the hardware. The formula for the MDA can be represented as follows:

$$MDA * Eff * Yield = \frac{a+\sqrt{b+c*Counts}}{Live\ time}$$

The MDA value is calculated in the MCB given the constants *a*, *b*, and *c*. *Counts* is the gross counts in the specified region and *Live time* is the live time. The constants *a*, *b*, and *c*, and the total left-hand factor (expected value) are loaded into the MCB by the user. The calculated value (right-hand side) is compared with the expected value and when it is lower, acquisition is stopped.

4.5. Interface Connectors (Rear-Panel)

DUAL PORT MEMORY ORTEC dual-port interface, 37-pin D connector.

RS232C Standard, serial, male RS-232-C, 25-pin; wired as DTE to run at 38.4k baud maximum, with modem control. (For diagnostics.)

ETHERNET Rear-panel BNC connector, accepts IEEE 802.3 10BASE2 (thin-wire coax).

4.6. ADC

Successive-approximation ADC with sliding-scale linearization, 16,000-channel resolution; software selectable as 16k, 8k, 4k, 2k, 1k, and 512 channels.

Dead Time per Event 1.5 μs, including memory transfer (measured at 5-μs shaping with ORTEC Model 973 High-Rate Spectroscopy Amplifier at 100,000 counts/sec input count rate).

Integral Nonlinearity ≤±0.025% over 99% dynamic range.

Differential Nonlinearity ≤±1% (typical).

Gain Instability ≤±50 ppm/°C.

Dead-time Correction Extended live-time correction according to the Gedcke-Hale method.[1]

4.7. Controls (Front-Panel)

ADC LLD Screwdriver potentiometer adjust lower-level discriminator from 0–10% full scale.

ADC ZERO Screwdriver potentiometer adjusts ADC zero offset ±250 mV.

4.8. Digital Spectrum Stabilizer

ADC Data Word Size 14 bits (16k channels) maximum.

Stabilization Peak centroid (zero and gain) channel 2 to 16384; stabilization window width (zero and gain) from ±1 to ±256 channels.

Correction Resolution At 16k ADC resolution: 0.04 channels for gain; <0.08 channels for zero.

Setup/Enable/Disable From computer.

4.9. Electrical and Mechanical

Dimensions NIM-standard two-wide 6.90 × 22.13 cm (2.70 × 8.714 in.) front panel per DOE/ER-0457T.

Weight

Net 2.25 kg (5 lb).
Shipping 3.1 kg (7 lb).

Power Requirements +24 V, 160 mA; −24 V, 240 mA; +12 V, 900 mA; −12 V, 260mA; +6 V, 1.0 A. An ORTEC Model 4001A/4002D NIM Bin/Power Supply is recommended for up to five Model 921E units. The ORTEC Model 495 Power Supply is available for NIM bins that do not have 6 V power.

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[1]Ron Jenkins, R. W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp. 266–267.

4.10. Battery Backup

The memory in the Model 921E has battery backup to maintain data when power is removed from the module.

Battery High-energy lithium, 3.6 V, ORTEC P/N 739460.

4.11. Feature Mask Bits

The following table describes the feature bits from the SHOW_FEATURES command discussed on page 39. If the feature is supported in the Model 921E, the bit will be set to 1; if the feature is not supported, the bit will be 0.

Bit	Meaning
0	Software-selectable conversion gain
1	Software-selectable coarse gain
2	Software-selectable fine gain
3	Gain stabilizer
4	Zero stabilizer
5	PHA mode functions available
6	MCS mode functions available
7	List mode functions available
8	Sample mode functions available
9	Digital Offset (e.g., 920)
10	Software-selectable Fine Offset (e.g., DART®)
11	HV power supply
12	Enhanced HV (SET_HV, SET/SHOW_HV_POL, SHOW_HV_ACT)
13	Software-selectable HV range (ENA_NAI, DIS_NAI)
14	Auto PZ (START_PZ_AUTO)
15	Software-selectable manual PZ (SET/SHOW_PZ)
16	Internal clock (SHOW_DATE/TIME, SHOW_DATE/TIME_START)
17	Sample Changer support (SET/SHOW_OUTPUT, SHOW_INPUT)
18	One-button acquisition (ENA/DIS/SHOW_TRIG_SPEC, MOVE)
19	Nomadic (likely to move between opens)
20	Local app data (SET_DATA_APP, SHOW_DATA_APP)

Bit	Meaning
21	Software-retrievable serial number
22	Power management commands
23	Battery status support
24	Software-selectable AMP polarity (SET/SHOW_GAIN_POLAR)
25	Support for flattop optimization (ENA/DIS_OPTI)
26	Stoppable AutoPZ
27	Network support (i.e., 92X-II)
28	Multi-drop serial support (e.g., RS-485)
29	Software-selectable DPM address
30	Multiple devices (e.g., 919)
31	Software-selectable ADC gate mode (SET_GATE...)
32	Downloadable firmware
33	Time histogram functions available (e.g., 9308)
34	Software-selectable Lower level disc
35	Software-selectable Upper level disc
36	MCS-mode SCA input available
37	MCS-mode positive TTL input available
38	MCS-mode fast-negative NIM input available
39	MCS-mode discriminator input available
40	Software-switchable discriminator edge
41	Software-programmable discriminator level
42	Software-programmable SCA upper and lower thresholds
43	Software-selectable MCS-mode input sources
44	Statistical preset
45	Features vary by input (SHOW_FEATURES depends on device/segment)
46	Software-selectable HV shutdown mode
47	Software-selectable shaping time constants
48	Explorable shaping time constants (SHOW_CONFIG_SHAP)
49	Advanced shaping time (SET_SHAP_RISE, SET_SHAPE_FLAT, etc.)
50	Software-selectable BLR (ENA/DIS/SHO_BLR_AUTO SET/SHO/VERI_BLR)
51	SHOW_STATUS command supported (returns $M record)
52	Overflow preset (ENA/DIS/SHO_OVER_PRES)

Bit	Meaning
53	Software-enabled audio clicker (ENA/DIS_CLICK)
54	Software-readable thermistor (SHOW_THERM)
55	Fine Gain is float number (SET/SHO/VERI/LIST_GAIN_FINE)
56	Software-enabled Pile-up Rejector. (ENA/DIS/SHO_PUR, SET_WIDT_REJ)
57	Alpha-style HV power (SHOW_HV_CURRENT)
58	Software-readable vacuum (SHOW_VACUUM)
59	Acquisition alarms (ENA/DIS_ALARM)
60	Hardware acquisition trigger (ENA/DIS_TRIG)
61	Ordinal shaping times (SET_SHAP 0, SET_SHAP 1, ...)
62	Query gain ranges (LIST/VERI_GAIN_FINE, ..._COAR, ..._CONV)
63	Routable inputs (SET/SHOW_INPUT_ROUTE)
64	External dwell support (ENA/DIS_DWELL_EXT)
65	Selectable SUM or REPLACE MCS modes (ENA/DIS_SUM)
66	External Start support (ENA/DIS/SHO_START_EXT)
67	Explorable MCS (LIST_SOURCE, LIST_LLSCA & LIST_ULSCA)
68	Device support the MDA preset (DSPEC and 92X-II)
69	Software-selectable ADC type (Matchmaker™)
70	Has ability to daisy-chain MCBs (DART®)
127	Extended feature mask available (SH_FEAT_EXT)

APPENDIX A. FIRMWARE COMMANDS AND RESPONSES

Software communication with the 921E takes place through the CONNECTIONS-32 software layer. CONNECTIONS-32 is used by all ORTEC software and is available for other software development with our CONNECTIONS-32 Programmer's Toolkit with Microsoft® ActiveX® Controls (A11-B32).

A.1. CONNECTIONS-32

In CONNECTIONS-32, the communication consists of sending command records to the MCB API and receiving response records from the MCB API. Both command and response records consist of a sequence of printable ASCII characters followed by an ASCII carriage return. The single exception to this rule is the "#B" response record for the WRITE command, which contains binary integer numbers. All commands eventually respond with a percent response record (so named because the response begins with an ASCII percent sign "%") which signifies the completion of the command. SHOW and STEP commands respond with a dollar response record (which begins with an ASCII dollar sign "$") followed by a percent response record. The WRITE command can respond with multiple pound sign records (which begin with an ASCII pound sign "#") but eventually completes by sending a percent response record. All other commands result in a single percent response record upon completion.

A.2. Command Records

Model 921E commands consist of a command header, which may be followed by numeric parameter values. The header consists of a verb or a verb and noun separated by an underscore or a verb, noun, and modifier, each separated by underscores. The verbs, nouns, and modifiers in the command header are mnemonic words such as the verb ENABLE or the noun OVERFLOW that relate to the function performed by the MCB when it executes the command. The first four letters of any word will always be enough to uniquely identify the word when composing commands for an MCB. For example, the command ENABLE_OVERFLOW_PRESET can be abbreviated to ENAB_OVER_PRES.

Numeric parameters are unsigned integer numbers that follow the command header separated by one or more spaces. Specific commands require up to three parameters, separated by commas, which specify numeric quantities related to the operation of the MCB, such as live time or conversion gain. The command SET_WINDOW 0,16384 has two parameters, 0 and 16384, which set the window of interest to start at channel 0 and continue for 16384 channels.

Some parameters listed in the command dictionary are considered optional and are distinguished from mandatory parameters by being surrounded by brackets in the command prototype line (e.g., SET_WINDOW [start,length]). Commands that have optional parameters may be sent to the MCB without the optional parameters, in which case the behavior will be changed as explained in the command description.

An optional checksum can be added to the end of any command sent to an MCB. The checksum is a 1-byte unsigned integer sum of all of the characters in a command, treated as unsigned integers, up to and including the comma or space(s) that separates the checksum from the command. The checksum simply appears as an extra parameter added to the end of the command parameter list. For commands that do not normally have parameters, the checksum appears as the only parameter separated from the header by one or more spaces. All optional parameters must be included in a command if a checksum is to be provided so that the checksum is not mistaken by the MCB as a parameter. For example, the SET_WINDOW command must include the two optional parameters, start and length, if the checksum is provided (e.g., SET_WINDOW 0,16384,209).

A.3. Percent Response Records

Model 921E MCBs respond to all commands with a percent response record that signifies the completion of the command. Percent response records contain two error code numbers and a 1-byte checksum as follows:

%aaabbbccc<CR>

where % represents the ASCII % character, aaa represents the macro error code, bbb represents the micro error code, ccc represents the checksum and <CR> represents the ASCII carriage return character signifying the end of the record. The macro error code represents the general class of error with 0 meaning no error, and the micro error code represents the sub-class of error with 0 meaning no error. The following table lists all percent responses for a Model 921E:

Unconditional Success:

%000000069<CR>	No errors detected. Command executed as specified.

START and STOP Warnings:

%000005074<CR>	Device already started or stopped. The START or STOP command was ignored.
%000006075<CR>	Device preset already exceeded. The START command was ignored.

Power-Up Alert:

Power-up just occurred and the selftest results are:

%001000070<CR>	All power-up selftest passed.
%003000072<CR>	Battery backed-up data lost.
%005002076<CR>	ROM1 failed selftest.
%005004078<CR>	ROM2 failed selftest.
%005006080<CR>	ROM1 and ROM2 failed selftest.
%005008082<CR>	Processor memory failed selftest.
%005010075<CR>	ROM1 and processor memory failed selftest.
%005012077<CR>	ROM2 and processor memory failed selftest.
%005014079<CR>	ROM1, ROM2 and processor memory failed selftest.
%007002078<CR>	Battery backed-up data lost and ROM1 failed selftest.
%007004080<CR>	Battery backed-up data lost and ROM2 failed selftest.
%007006082<CR>	Battery backed-up data lost, ROM1 and ROM2 failed selftest.
%007008084<CR>	Battery backed-up data lost and processor memory failed selftest.
%007010077<CR>	Battery backed-up data lost, ROM1 and processor memory failed selftest.
%007012079<CR>	Battery backed-up data lost, ROM2 and processor memory failed selftest.
%007014081<CR>	Battery backed-up data lost, ROM1, ROM2 and processor memory failed selftest.

TEST command Results:

%004002075<CR>	ROM1 failed test.
%004004077<CR>	ROM2 failed test.
%004008081<CR>	Processor Memory failed test.
%004016080<CR>	Spectral Data Memory or Mailbox Memory failed test.
%004032078<CR>	RESERVED.
%004064083<CR>	Serial Line failed test.

Note that the above responses can be combined to indicate a combination of errors such as:

%004006079<CR>	ROM1 and ROM2 both failed test.
%004010074<CR>	Processor Memory and ROM both failed test.

Command Syntax Errors:

%129001082<CR>	Invalid command verb.
%129002083<CR>	Invalid command noun.
%129003084<CR>	Invalid command verb and noun.
%129004085<CR>	Invalid command modifier.
%129005086<CR>	Invalid command verb and modifier.
%129006087<CR>	Invalid command noun and modifier.
%129007088<CR>	Invalid command verb, noun and modifier.
%129132087<CR>	Invalid command (verb, noun and modifier valid but not together).

Communication Errors:

%130001074<CR>	Serial line buffer overrun.
%130002075<CR>	Serial line parity error.
%130003076<CR>	Serial line buffer overrun and parity error.
%130004077<CR>	Serial line framing error.
%130005078<CR>	Serial line buffer overrun and framing error.
%130006079<CR>	Serial line parity error and framing error.
%130007080<CR>	Serial line buffer overrun, parity error and framing error.
%130008081<CR>	Serial line break detected.
%130128084<CR>	Command checksum incorrect (only when optional checksum provided).
%130129085<CR>	Command (or WRITE handshake) record too long.
%130131078<CR>	WRITE command aborted by “HA” handshake.
%130132079<CR>	WRITE command aborted by timeout.
%130133080<CR>	WRITE command aborted by invalid handshake.

Execution Errors:

%131128085<CR>	Invalid 1st command parameter.
%131129086<CR>	Invalid 2nd command parameter.
%131130078<CR>	Invalid 3rd command parameter.
%131132080<CR>	Invalid number of command parameters.
%131134082<CR>	Invalid device or segment selected.
%131135083<CR>	Command not allowed while acquisition in progress.
%131136084<CR>	Command not allowed in current mode of operation.
%131137085<CR>	Hardware failure detected while processing command.

A.4. Dollar Response Records

SHOW and STEP commands respond with a single dollar response record followed immediately by a percent response record. All valid dollar response records for each command are listed in the command dictionary.

The following table lists the general form of each dollar response record for a Model 921E. In this table lower case letters represent numeric values. The letters "ccc" always represent an 8-bit unsigned checksum of all characters on the record up to but not including the checksum characters, and **<CR>** represents the ASCII carriage return character.

$Axxxccc<CR>	xxx is a single 8-bit unsigned number.
$Cxxxxxccc<CR>	xxxxx is a single 16-bit unsigned number.
$Dxxxxxyyyyyccc<CR>	xxxxx and yyyyy are 16-bit unsigned numbers.
$Exxxxxccc<CR>	xxxxx is a single 16-bit alarm mask.
$Fssss...<CR>	ssss... is a variable length ASCII character sequence (no checksum is sent with this record).
$Gxxxxxxxxxxccc<CR>	xxxxxxxxxx is a single 32-bit unsigned number.
$IT<CR>	True response to a SHOW command (no checksum).
$IF<CR>	False response to a SHOW command (no checksum).
$Jxxxxxyyyyy...ccc<CR>	Response to SHOW_CONFIGURATION command.
$Mxxxxxxxxxx...ccc<CR>	Response to SHOW_STATUS command.
$Nxxxyyyzzzccc<CR>	xxx, yyy and zzz are 8-bit unsigned numbers.

A.5. Command Catalog

This section lists each Model 921E command with a description of its operation. The descriptions include a list of any unusual responses that may result. As described in previous sections, the usual response from a command is a %000000069<CR> response, which represents a macro error code of 0 and a micro error code of 0 (no errors).

All execution error responses, if any, are listed for each command. Though syntax and communication error responses may result from any command, in practice, these error responses rarely occur on systems with reliable communication hardware running debugged software. Refer to Section A.3 for information about error responses.

In the following catalog the commands are listed in alphabetical order, each starting with a command prototype line. Upper-case letters, numeric digits, blank space and special symbols such as the underscore "_" and comma "," in the prototype line are literal text to be sent to the MCB exactly as it appears. Lower-case letters in the prototype line represent numeric values as described in the accompanying text and should not be sent literally to the MCB but should be

replaced by an appropriate numeric value. Items in the command prototype that are surrounded by brackets "[...]" are optional items and are not always required.

In this section the term <CR> represents the ASCII carriage return character, decimal value 13, and the character "_" represents the ASCII underscore character, decimal value 95.

CLEAR

The channels of spectral data in the window of interest (see SET_WINDOW command) for the Model 921E (see SET_DEVICE command) are set to zero. The live time and true time counters for the MCB are also set to zero. This command is equivalent to the combination of CLEAR_COUNTERS and CLEAR_DATA commands.

CLEAR_ALL

This command is equivalent to the combination of CLEAR_COUNTERS, CLEAR_DATA, CLEAR_PRESETS and CLEAR_ROI commands.

Execution Errors:

%131135083<CR>	The command was attempted while spectrum acquisition was in progress. No action was taken.

CLEAR_COUNTERS

The live-time and true-time counters for the MCB (see SET_DEVICE command) are set to zero.

CLEAR_DATA

The channels of spectral data in the window of interest (see SET_WINDOW command) for the MCB (see SET_DEVICE command) are set to zero. The ROI flags are not changed, nor are the presets changed.

CLEAR_PRESETS

The live time, true time, ROI integral, ROI peak and overflow presets are all set to zero (disabled) for the MCB (see SET_DEVICE command).

Execution Errors:

%131135083<CR>	The command was attempted while spectrum acquisition was in progress. No action was taken.

CLEAR_ROI

The region-of-interest flags for the channels in the window of interest (see SET_WINDOW command) in the MCB (see SET_DEVICE command) are cleared.

Execution Errors:

%131135083<CR>	The command was attempted while spectrum acquisition was in progress. No action was taken.

CLOSE_FILE "filename"

Completes download of file to RAM Disk in the MCB. See OPEN_FILE and WRITE_FILE. This command may also be used to terminate a download to the FLASH without reprogramming the FLASH.

CLOSE_FILE_FLASH crc

Completes download of FLASH data. crc is the CRC checksum of the data which was downloaded. See OPEN_FILE_FLASH and WRITE_FILE_FLASH.

Execution Errors:

%131132080<CR>	Invalid number of command parameters.

COMPUTER

Prepares the serial line for communication with a computer. In computer mode, text sent to the 921E does not echo back to the host, and response records sent to the host by the 921E are terminated only with a carriage return (no accompanying line feed). This command has no effect when sent via the mailbox. See also TERMINAL.

DELETE_FILE "filename.ext"

Removes the specified file from the RAM Disk. This is not normally used.

Execution Errors:

%131128085<CR>	Filename required.
%131137085<CR>	Hardware failure.

DISABLE_ALARM

Ends the transmission of alarm responses when the MCB stops counting. Alarm responses are disabled for the serial line and the mailbox communication paths independently. See also ENABLE_ALARM and SHOW_ALARM.

DISABLE_GAIN_STABILIZATION

Stops stabilization of the gain peak while data is being acquired. The gain stabilization adjustment is held at its current value until either gain stabilization is reenabled with the ENABLE_GAIN_STABILIZATION command or reinitialized with the INITIALIZE_ GAIN_STABILIZATION, SET_GAIN_PEAK, or SET_GAIN_WIDTH command. See Appendix B for more information. See also SHOW_GAIN_STABILIZATION.

DISABLE_OVERFLOW_PRESET

Disables the overflow preset for the MCB. Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will roll over to zero counts if the overflow preset is disabled. See also ENABLE_OVERFLOW_PRESET and SHOW_OVERFLOW_PRESET.

DISABLE_REMOTE

Disables the recognition of commands on the alternate communication paths. If this command is sent to the Model 921E via the mailbox communication path, it disables command recognition on the serial path. If this command is sent via the serial path, it disables command recognition on the mailbox communication path. See also ENABLE_REMOTE and SHOW_REMOTE.

DISABLE_TRIGGER

Disables the data acquisition trigger that was enabled by the ENABLE_TRIGGER command. See TRIGGER, ENABLE_TRIGGER, and SHOW_TRIGGER.

DISABLE_ZERO_STABILIZATION

Stops stabilization of the zero peak while data is being acquired. The zero stabilization adjustment is held at its current value until either zero stabilization is reenabled with the ENABLE_ZERO_STABILIZATION command or reinitialized with the INITIALIZE_ ZERO_STABILIZATION, SET_ZERO_CHANNEL or SET_ZERO_WIDTH commands. See Appendix B for more information. See also SHOW_ZERO_STABILIZATION.

ENABLE_ALARM

Begins the transmission of alarm responses, $E records, when an input stops counting. A $E response record will be transmitted only when no host commands are being processed (after a % response from a previous command and before another ckmmand is sent). Alarm responses are enabled for the serial line and the mailbox communication paths independently. If the command is sent to the MCB via the mailbox, then alarms will be sent to the mailbox. If the command is sent via the serial line, then alarms will be sent via the serial line. Alarms can be enabled for both communication paths at the same time. See also DISABLE_ALARM and SHOW_ALARM.

ENABLE_GAIN_STABILIZATION

Enables the stabilization of the gain peak by the previously selected method, either Gauss mode or point mode (see SET_MODE_GAUSS and SET_MODE_POINT). See Appendix B for more information. See also DISABLE_GAIN_STABILIZATION, SHOW_GAIN_ STABILIZATION, and INITIALIZE_GAIN_STABILIZATION.

ENABLE_OVERFLOW_PRESET

Enables the overflow preset for the MCB. Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will stop the acquisition for that channel if the overflow preset is disabled. The channel that caused the preset to complete will contain 214783647 counts. An alarm response record will be sent to the host if alarms

are enabled for the MCB whose acquisition is stopped (see ENABLE_ALARM command). See also DISABLE_OVERFLOW_PRESET and SHOW_OVERFLOW_PRESET commands.

ENABLE_REMOTE

Enables the recognition of commands on the alternate communication path. If this command is sent to the Model 921E via the mailbox, it enables command recognition on the serial line. If this command is sent via the serial line it enables command recognition in the mailbox.

ENABLE_TRIGGER

Prepares for the start of data acquisition but does not actually start acquisition. After the successful execution of this command, the MCB is armed for data acquisition. While the MCB is armed, it will report that it is active (SHOW_ACTIVE). The acquisition may be started by an edge on the SAMPLE READY connector or by the TRIGGER command.

ENABLE_ZERO_STABILIZATION

Enables the stabilization of the zero peak by the previously selected method, either Gauss mode or point mode (see SET_MODE_GAUSS and SET_MODE_POINT). See Appendix B for more information. See also DISABLE_ZERO_STABILIZATION, SHOW_ZERO_ STABILIZATION, and INITIALIZE_ZERO_STABILIZATION.

INITIALIZE

Resets the Model 921E to initial conditions as though the following commands had been issued:

COMPUTER	SET_RADIX_BINARY
DISABLE_GAIN_STABILIZATION	SET_SEGMENT 1
DISABLE_ZERO_STABILIZATION	SET_WIDTH 512
SET_DEVICE 1	SET_WINDOW 0,16384
SET_GAIN_ADJUST 2048	SET_ZERO_ADJUST 2048
SET_GAIN_PRESET 10	SET_ZERO-PRESET 10
SET_GATE_OFF	TEST 1
SET_MODE_POINT	

The following commands are issued for both Mailbox and Serial communication paths:

DISABLE_ALARM	ENABLE_REMOTE

The following commands are issued for the MCB:

CLEAR_ALL	SET_GAIN_CONVERSION 16384
STOP	

In addition, the INITIALIZE command resets all internal hardware and internally marks the stabilizer gain channel, gain width, zero channel and zero width as undefined. After an INITIALIZE command the SET_GAIN_CHANNEL and SET_GAIN_WIDTH commands must be issued before gain stabilization can be enabled with the ENABLE_GAIN_STABILIZATION command. Likewise, the SET_ZERO_CHANNEL and SET_ZERO_WIDTH commands must be issued before zero stabilization can be enabled with the ENABLE_ZERO_STABILIZATION command.

Execution Errors:

The INITIALIZE command simulates a power-down/power-up cycle for the MCB after a simulated loss of battery backed-up memory. Thus the % response record is the response from the TEST 1 command as listed above.

%003000072<CR>	MCB Power-up occurred/Memory lost/No selftest errors (normal response for INITIALIZE command).
%007002078<CR>	All of above but selftest failed/ROM1 failed.
%007004080<CR>	All of above but ROM2 failed.
%007006082<CR>	All of the above but ROM1 and ROM2 both failed selftest.

INITIALIZE_GAIN_STABILIZATION

Resets the gain peak stabilization adjustment to unity (no adjustment). This value is reported as 2048 by the SHOW_GAIN_ADJUSTMENT command. See Appendix B for more information. See also SET_GAIN_ADJUSTMENT, ENABLE_GAIN_STABILIZATION, and DISABLE_GAIN_STABILIZATION.

INITIALIZE_ZERO_STABILIZATION

Resets the zero peak stabilization adjustment po unity (no adjustment). This value is reported as 2048 by the SHOW_ZERO_ADJUSTMENT command. See Appendix B for more information. See also SET_ZERO_ADJUSTMENT, ENABLE_ZERO_STABILIZATION, and DISABLE_ZERO_STABILIZATION.

LIST_GAIN_ADJUST

Returns a string that gives the minimum and maximum values of the gain stabilizer settings in “real-world” values and DAC values. DAC values are appropriate for the SET_GAIN_ADJUSTMENT command.

Example Response:

–100 100 0 4095	Zero is –100% of the allowable range and 4095 is +100%; 2048 is 0% or no adjustment.

LIST_GAIN_CONVERSION

Returns a string that enumerates each legal conversion gain setting separated by a space.

Example Response:

GAIN_CONV 512 1024 2048 4096 8192 16384

LIST_GATE

Returns a string that lists the legal gate settings.

Example Response:

GATE OFF COINCIDENT ANTICOINCIDENT

LIST_ZERO_ADJUST

Returns a string that gives the minimum and maximum values of the zero stabilizer settings in "real-world" values and DAC values. DAC values are appropriate for the SET_ZERO_ADJUSTMENT command.

Example Response:

−100 100 0 4095	Zero is −100% of the allowable range and 4095 is +100%; 2048 is 0% or no adjustment.

OPEN_FILE "filename.ext"

A filename is needed to open a file. Begins the download of a file to the RAM Disk by opening **filename.ext** on the RAM Disk. See WRITE_FILE and CLOSE_FILE.

OPEN_FILE_FLASH

Begins the download of a new FLASH (ROM DISK). This command removes all files on the RAM Disk except **autoexec.bat** and **ini83905.exe** to make room for **ROMDISK.ABS**. It also stops all acquisitions which are in progress. See WRITE_FILE_FLASH and CLOSE_FILE_FLASH.

PAUSE_INPUT [input-num]

Waits for the next transition on the Sample Ready input or the beginning of the next command before responding with a **%** response record. If input-num is present, it must be 0. This parameter is provided for compatibility with other ORTEC modules.

Responses:

%000000069<CR>	Transition on Sample Ready input occurred
%130131041<CR>	Command was aborted by beginning of next command

PAUSE_INPUT_HIGH [input-num]

Waits for a high level to be detected on the Sample Ready input or for the beginning of the next command before responding with a **%** response record. The input level must remain high until the MCB responds; otherwise, it may not be detected. If input-num is provided, it must be zero. This parameter is provided for compatibility with other ORTEC modules.

Responses:

%000000069<CR>	High level was detected on the input
%130131041<CR>	Command was aborted by beginning of next command

PAUSE_INPUT_LOW [input-num]

Waits for a low level to be detected on the Sample Ready input or for the beginning of the next command before responding with a **%** response record. The input level must remain low until the MCB responds; otherwise, it may not be detected. If input-num is provided, it must be zero. This parameter is provided for compatibility with other ORTEC modules.

Responses:

%000000069<CR>	Low level was detected on the input
%130131041<CR>	Command was aborted by beginning of next command

REBOOT

Reboots the MCB. This command is not normally used and may terminate communication. MCB returns a 000130.

RESET

Resets the 921E to the state just after power is applied. This command responds with a **%** response that indicates power-up just occurred.

RESET_REMOTE

Resets any UART error conditions when sent to the 921E via the mailbox. Resets mailbox communications when sent to the 921E via the serial communications path.

SET_ADC_HOLDOFF holdoff

Prevents data acquisition from monopolizing the microprocessor, so the microprocessor can perform other tasks such as communication with the host computer. Holdoff can be from 0 to 65535. This command is not normally used. See also SHOW_ADC_HOLDOFF.

SET_CONFIGURATION_UART "bbbbbpds"

A syntax error. See also SHOW_CONFIGURATION_UART. Sets the baud rate, parity, number of data bits and the number of stop bits for serial port communication. The parameter is an ASCII string which specifies the settings where bbbbb is the baud rate with leading zeros if necessary, p is replaced with O, E, or N to indicate odd, even, or no parity, d is replaced with the number of data bits (5–8), and s is replaced with the number of stop bits (1–2). For example SET_CONFIG_UART "09600N81" sets the baud rate to 9600, disables parity checking, sets the number of bits to 8 and the number of stop bits to 1.

SET_DATA count

Sets all channels of spectral data in the window of interest (see SET_WINDOW command) for the MCB to the specified count. ROI flags are not affected.

SET_DATA_APP "entry","data"

Stores information such as sample descriptions and energy calibrations in the MCB internal memory that can be used by other programs. Entry (32 characters maximum) specifies the type of information to store with data (128 characters maximum).

SET_DATE day,month,year

Sets the date stored in the battery backed-up system clock to the specified values. Day can be any value from 1 to 31. Month can be any value from 1 through 12. Year can be any value from 0 through 99. The current date and time are stored for the MCB when an acquisition is started. See also SHOW_DATE, SET_TIME and SHOW_TIME.

SET_DATE day,month,year

Sets the date stored in the battery backed-up system clock to the specified values. Day can be any value from 1 to 31. Month can be any value from 1 through 12. Year can be any value from 0 through 99. The current date and time are stored for the MCB when an acquisition is started. See also SHOW_DATE, SET_TIME, and SHOW_TIME.

SET_DATE_START day,month,year

Sets the start date for the MCB to the specified values. Normally the start date and time are set automatically whenever the MCB is started with the START command. See also SHOW_DATE_START, SET_TIME_START, and SHOW_TIME_START.

SET_DEBUG level

Sets the debug level to level, which must be between 0 and 255. Setting level to a non-zero value causes debugging information to be transmitted to the serial port. See also SHOW_DEBUG.

SET_DEVICE device

Included for compatibility with other MCBs. Only device number 1 is valid for a Model 921E.

Execution Errors:

%131128085<CR>	An invalid device number was given.

SET_GAIN_ADJUSTMENT value

Sets the gain stabilization adjustment to an arbitrary value from 0 to 4095. The total range of the adjustment value represents a ±0.5% change in the signal gain, with a value of 2048 representing unity gain. This adjustment is usually made only by the gain stabilizer and reset to unity with the INITIALIZE_GAIN_STABILIZATION command. See Appendix B for more information. See also SHOW_GAIN_ADJUSTMENT.

SET_GAIN_CHANNEL chan

Sets the center channel for the stabilizer gain peak for the MCB. If a gain channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel as determined by the conversion gain, the gain peak width is reduced until the peak fits the MCB boundaries. A gain channel and width must be set before gain stabilization can be enabled. See Appendix B for more information.

Execution Errors:

%131128085<CR>	The specified channel number would create a peak that was less than the minimum (3 channel) width or would be outside the MCB's range.
%131136084<CR>	The command was attempted while gain stabilization was enabled.

SET_GAIN_CONVERSION chans

Sets the conversion gain for the MCB. The conversion gain defines the number of channels within the MCB that will used for spectral data. This has the effect of altering the resolution of the ADC from 14 bits (conversion gain = 16384) to 9 bits (conversion gain = 512) for the MCB. See also SHOW_GAIN_CONVERSION.

Legal Commands:

SET_GAIN_CONVERSION 0<CR>	Conversion gain set to default (16384).
SET_GAIN_CONVERSION 512<CR>	Conversion gain set to 512 channels.
SET_GAIN_CONVERSION 1024<CR>	Conversion gain set to 1024 channels.
SET_GAIN_CONVERSION 2048<CR>	Conversion gain set to 2048 channels.
SET_GAIN_CONVERSION 4096<CR>	Conversion gain set to 4096 channels.
SET_GAIN_CONVERSION 8192<CR>	Conversion gain set to 8192 channels.
SET_GAIN_CONVERSION 16384<CR>	Conversion gain set to 16384 channels.

SET_GAIN_PRESET count

Sets the Gauss mode stabilization preset for the gain peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the gain peak before the gain is evaluated by the stabilizer and potentially adjusted. See Appendix B for more information. See also SHOW_GAIN_PRESET.

SET_GAIN_WIDTH chans

Sets the width in channels for the stabilizer gain peak for the MCB. The gain width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The gain channel and width must be set before gain stabilization can be enabled. The absolute minimum width for the gain peak is 3 channels, and the absolute maximum width for the gain peak is 256 channels in Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the MCB's channel limits as stated above. See Appendix B for more information. See also SHOW_GAIN_WIDTH, SET_GAIN_CHANNEL and SHOW_GAIN_CHANNEL.

Execution Errors:

%131128085<CR>	The specified number of channels would create a peak that was less than the minimum (3 channel) width or would be outside the MCB's range.
%131136084<CR>	The command was attempted while gain stabilization was enabled.

SET_GATE_ANTICOINCIDENT

Causes the 921E to expect the ADC gate input signal in anticoincident mode. See Section 4.2 for more information on the ADC GATE input. See also SET_GATE_OFF, SET_GATE_COINCIDENT, and SHOW_GATE.

SET_GATE_COINCIDENT

Causes the 921E to expect the ADC gate input signal in coincident mode. See Section 4.2 for more information on the ADC GATE input. See also SET_GATE_OFF, SET_GATE_ANTICOINCIDENT, and SHOW_GATE.

SET_GATE_OFF

Causes the 921E to ignore the state of the ADC gate input signal. See Section 4.2 for more information on the ADC GATE input. See also SET_GATE_COINCIDENT, SET_GATE_ANTICOINCIDENT and SHOW_GATE.

SET_INTEGRAL_PRESET count

Sets the ROI integral preset for the MCB to the specified count. During data acquisition when the sum of the counts contained in the channels of the MCB that have the ROI flag set reaches the integral preset count, the preset is complete and the acquisition is stopped. The actual number of counts in the ROI integral may exceed the preset value by up to 512 counts due to the pipelined architecture of the Model 921E. Setting an integral preset to 0 counts disables the preset. The integral preset can be set to from 0 (disabled) to 4294967295 counts. See also CLEAR_PRESETS and SHOW_INTEGRAL_PRESET.

Execution Errors:

%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_LIVE ticks

Sets the live-time counter for the MCB to the specified number of ticks. The number represents live time in units of 20 ms (50 ticks per second). Normally this value is set by the Model 921E during data acquisition. See also CLEAR_COUNTERS and SHOW_LIVE.

Execution Errors:

%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_LIVE_PRESET ticks

Sets the live-time preset for the MCB to the specified number of ticks. During data acquisition when the live-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a live-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_LIVE_PRESET.

Execution Errors:

%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_MDA_COEF a,b,c

Sets the coefficients in the MDA preset calculation to the specified values; a, b, and c are floating-point values. The MDA preset stops the calculation when the following condition is met:

$$MDA\ Preset > \frac{a + \sqrt{b + c * CountsinROI}}{Live\ time}$$

The MDA preset calculation is performed once per minute.

SET_MDA_PRESET preset

Sets the MDA preset to the specified value. The preset is the product of the desired MDA, the efficiency, and the yield.

SET_MODE_GAUSS

Sets the method of stabilization for both gain and zero stabilization peaks to Gauss mode. The maximum peak width is 256 channels in Gauss mode, so that either the gain or zero (or both) peak(s) can be reduced in width. See Appendix B for more information. See also SET_MODE_POINT.

SET_MODE_PHA

The mode is set to PHA, the only mode for the Model 921E. This command is included for compatibility with other MCBs.

SET_MODE_POINT

Sets the method of stabilization for both gain and zero stabilization peaks to point mode. See Appendix B for more information. See also SET_MODE_GAUSS.

SET_NETWORK_ID id

Establishes a new network identifier which is to be used by the MCB for ethernet communication. The setting only takes effect after a REBOOT. Id should be no more than 15 characters. See also SHOW_NETWORK_ID.

SET_NETWORK_ADDRESS [company,]addr

Establishes the Ethernet address used by the 83905 Ethernet chip. The company portion of the address is usually not included causing the EG&G ID (41020) to be used. The addr portion should not be the same on any two MCBs connected to the network. This address is assigned at the factory and should normally never be changed. See also SHOW_NETWORK_ADDRESS.

Execution Errors:

%131128085<CR> The number must be between 0 and 16777215.

SET_OUTPUT port, value

This sends the value to the port. The port number can be 0 or 1; 0 is the change sample output and 1 is the serial port. Value must be between 0 and 255. See also SHOW_OUTPUT.

SET_OUTPUT_HIGH [output-num]

Sets the Change Sample output to a high level. If output-num is provided, it must be zero. This parameter is provided for compatibility with other ORTEC modules.

SET_OUTPUT_LOW [output-num]

Sets the Change Sample output to a low level. If output-num is provided, it must be zero. This parameter is provided for compatibility with other ORTEC modules.

SET_PAGE num

Debugging command that maps the DPM to page num; num can range from 1 to 4. See also SHOW_PAGE.

SET_PEAK_PRESET count

Sets the ROI peak preset for the MCB to the specified count. During data acquisition when the contents of any channel that has the ROI flag set reaches the peak preset count, the preset is complete and the acquisition is stopped. The actual number of counts in the ROI peak may exceed the preset value by a small number of counts due to the pipelined architecture of the Model 921E. Setting a peak preset to 0 counts disables the preset. The peak preset can be set to from 0 (disabled) to 2147483647 counts. See also CLEAR_PRESETS and SHOW_PEAK_PRESET.

Execution Errors:

%131135083<CR>	The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_RADIX_BINARY

This command is provided for compatibility with other ORTEC MCBs. It specifies that binary records are to be used by the WRITE command for sending spectral data to the host computer via the serial line. This is the only radix supported by the Model 921E MCBs.

SET_ROI start_chan,number_of_chans

Sets the ROI flags for the specified channels in the MCB. This command can be used multiple times to set ROI flags without affecting previously set flags. ROI flags specify channels within the MCB that are considered for ROI integral and ROI peak presets.

SET_ROI_MDA start,chans

Sets the region to be used for the MDA preset calculation.

SET_ROI_UNCERTAINTY start, chans

Sets the region to be used for the uncertainty preset calculation. See also SHOW_ROI_UNCERTAINTY.

SET_SEGMENT number

Provided for compatibility with Model 918-type MCBs. This command has no effect for Model 921E MCBs. The segment number can be any value from 1 through 16.

Execution Errors:

%131128085<CR>	The specified segment number was either zero or a value >16.

SET_TIME hour,min,sec

Sets the time stored in the battery backed-up system clock to the specified values. Hour can be any value from 0 to 23. Min and sec can be any value from 0 through 59. The current date and time are stored for the MCB when an acquisition is started. See also SHOW_TIME, SET_DATE, SHOW_DATE, SET_TIME_START, and SHOW_TIME_START.

Execution Errors:

%131137085<CR>	The time could not be set due to a hardware malfunction. Hardware service may be required.

SET_TIME_START hour,min,sec

Sets the start time for the MCB to the specified values. Normally the start date and time are set automatically whenever the MCB is started with the START command. See also SHOW_TIME_START, SET_DATE_START, SHOW_DATE_START, SET_DATE and SET_TIME.

SET_TRUE ticks

Sets the true-time counter for the MCB to the specified number of ticks. The number represents true time in units of 20 ms (50 ticks per second). Normally this value is set by the Model 921E during data acquisition. See also CLEAR_COUNTERS and SHOW_TRUE.

Execution Errors:

%131135083<CR>	The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_TRUE_PRESET ticks

Sets the true-time preset for the MCB to the specified number of ticks. During data acquisition when the true-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a true-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_TRUE_PRESET.

Execution Errors:

%131135083<CR>	The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_UNCERTAINTY_PRESET percent

Sets the uncertainty preset to the specified value in percent. percent is a floating point value from 0 to 99.9999. See also SHOW_UNCERTAINTY_PRESET.

Execution Errors

%131128085<CR>	The value is incorrect.
%131132080<CR>	A value must be included.

SET_WIDTH bytes

Sets the maximum number of bytes that can be sent to the host computer by the WRITE command.

Legal Commands:

SET_WIDTH 0<CR>	Width set to default (512).
SET_WIDTH 12<CR>	Width set to minimum value of 12 bytes.
SET_WIDTH 512<CR>	Width set to maximum value of 512 bytes.

SET_WINDOW [start, length]

Sets the window of interest for the MCB to the specified start channel and number of channels. The channels of spectral data in the window of interest are affected by commands such as CLEAR, SET_DATA, and WRITE. If neither start or length is provided, the window is set to the maximum size allowed by the conversion gain specified for the MCB. The window of interest is always set to the maximum size after a SET_DEVICE command or a SET_SEGMENT command.

Execution Errors:

%131128085<CR>	The start channel was too high for the MCB's conversion gain.
%131129086<CR>	The length specified one or more channels that were too high for the MCB's conversion gain.
%131132080<CR>	The start channel was specified without a length. If one value is given the other must be also given.

SET_ZERO_ADJUSTMENT value

Sets the zero stabilization adjustment to an arbitrary value from 0 to 4095. The total range of the adjustment value represents a ±50 mV change in the signal offset with a value of 2048 representing unity offset. This adjustment is usually only made by the gain stabilizer and reset to unity with the INITIALIZE_ZERO_STABILIZATION command. See Appendix B for more information. See also SHOW_ZERO_ADJUSTMENT.

SET_ZERO_CHANNEL chan

Sets the center channel for the stabilizer zero peak for the Model 921E. If a zero channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel as determined by the conversion gain, the zero peak width is reduced until the peak fits the MCB's boundaries. A zero channel and width must be set before zero stabilization can be enabled (see ENABLE_ZERO_STABILIZATION). See Appendix B for more information.

Execution Errors:

%131128085<CR>	The specified channel number would create a peak that was less than the minimum (3 channel) width or would be outside the MCB's range.
%131136084<CR>	The command was attempted while zero stabilization was enabled.

SET_ZERO_PRESET count

Sets the Gauss mode stabilization preset for the zero peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the zero peak before the zero offset is evaluated by the stabilizer and potentially adjusted. See Appendix B for more information. See also SHOW_ZERO_PRESET.

SET_ZERO_WIDTH chans

Sets the width in channels for the stabilizer zero peak for the MCB. The zero width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The zero channel and width must be set before zero stabilization can be enabled. The absolute minimum width for the zero peak is 3 channels, and the absolute maximum width for the zero peak is 256 channels in

Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the MCB's channel limits as stated above. See Appendix B for more information.

Execution Errors:

%131128085<CR>	The specified number of channels would create a peak that was less than the minimum (3 channel) width or would be outside the MCB's range.
%131136084<CR>	The command was attempted while zero stabilization was enabled.

SHOW_ACTIVE

Returns a 1 if the ADC is active, acquiring spectral data, or 0 if it is not active.

Responses:

$C00000087<CR>	The ADC is not active.
$C00001088<CR>	The ADC is active.

SHOW_ACTIVE_DEVICES

Included for compatibility with other MCBs. Returns a bit mask of the currently active devices as follows:

Responses:

$C00000087<CR>	921E ADC is not active.
$C00001088<CR>	921E ADC is active.

SHOW_ADC_CONVERSION

Debugging command that returns the most recent conversion from the ADC. Returns 0 if no conversion is available. See also SET_ADC_CONVERSION command.

Responses:

$C00000087<CR>	No conversion available.
$C00405096<CR>	405 was the most recent conversion.

SHOW_ALARM

Returns a record that indicated whether the alarm responses are enabled or disabled for a communication path. If SHOW_ALARM is received on the serial line, the response represents whether alarms are enabled for the serial line. If SHOW_ALARM is received by the mailbox, the response represents whether alarms are enabled for the mailbox.

Responses:

$IT<CR>	Alarms are enabled for the specified communication path.
$IF<CR>	Alarms are disabled for the specified communication path.

SHOW_CONFIGURATION

Returns a record that indicates the hardware configuration of the MCB. The record contains information about the number of segments in an MCB (always one for the Model 921E), and the current conversion gain for each segment. The record is organized as follows:

$J1638400001aaaaa00000[65 zeros here for total of 75 zeros]**00000ccc**

where aaaaa represents the conversion gain for the one and only segment in the MCB, and ccc represents the record checksum. See Section A.2 for more information about response records and checksums.

SHOW_CONFIGURATION_MASK

Returns two masks, the first of which may be “anded” with data from the MCB to clear the ROI bit from the data. When the second mask value is “anded” with data from the MCB, the data bits are removed and only the ROI bit remains.

Response:

CONF_MASK 02147483647 02147483648

SHOW_CONFIGURATION_UART

Reports the baud rate, parity option, number of data bits, and number of stop bits for the serial interface.

Responses:

$F09600N81	9600 baud, No parity, 8 data bits, 1 stop bit.
$F19200E82	19200 baud, Even parity, 8 data bits, 2 stop bits.
$F02400O71	2400 baud, Odd parity, 7 data bits, 1 stop bits.

SHOW_DATA_APPLICATION "entry"

If entry matches entry from a previous SET_DATA_APPLICATION command, the data from the SET_DATA_APPLICATION command is returned in a $F record.

Execution Errors:

%131138085	Entry could not be matched.

SHOW_DATE

Returns the day, month and year of the current date as maintained in the 921E battery backed-up real time clock in the form dddmmmyy. The day is returned as a 3-digit integer number from 001 through 031. The month is returned as a 3-digit integer number from 001 through 012. And the year is returned as a 3-digit integer number from 000 through 099. See also SET_DATE_START.

Responses:

$N001001088052<CR>	Date reported as Jan 1, 1988.
$N031012009959<CR>	Date reported as Dec 31, 1999.
$N001001000036<CR>	Date reported as Jan 1, 2000.
$N031012008756<CR>	Date reported as Dec 31, 2087.

SHOW_DATE_START

Returns the day, month and year of the acquisition start date for the MCB in the form dddmmmyyy. The day is returned as a 3-digit integer number from 001 through 031. The month is returned as a 3-digit integer number from 001 through 012. And the year is returned as a 3-digit integer number from 000 through 099. See also SET_DATE_START.

Responses:

$N001001088052<CR>	Start date reported as Jan 1, 1988.
$N031012009959<CR>	Start date reported as Dec 31, 1999.
$N001001000036<CR>	Start date reported as Jan 1, 2000.
$N031012008756<CR>	Start date reported as Dec 31, 2087.

SHOW_DATE_TRIGGER

Responds with the date that the last valid trigger occurred either via the TRIGGER command or the Sample Ready input. If no valid trigger has occurred since power-up or if ENABLE_TRIGGER is sent followed by DISABLE_TRIGGER without a valid trigger, the command returns all zeros.

Example Responses:

$N000000000ccc	No valid triggers have occurred.
$N011002097ccc	Trigger occurred February 11, 1997.

SHOW_DEBUG

Shows the debug level. See also SET_DEBUG.

Responses:

$A003248	Returns the debug state as $Axxxccc where xxx is the debug level and ccc is the checksum.

SHOW_DEVICE

Included for compatibility with other MCBs. Always returns 1 as the number of the MCB.

Responses:

$A001246<CR>	Device number 1 is currently selected device.

SHOW_DIRECTORY ["filename.ext"]

Responds with the first item in the RAM disk or ROM disk directory that matches the specified file name. Wildcards are permissible, and if a drive letter is included, **A:** should be used for the ROM disk and **C:** should be used for the RAM disk. If no drive letter is included, **C:** is used. If no filename is included, **C:*.*** is used. SHOW_DIRECTORY_NEXT returns the next entry in the directory list.

Responses:

MCBLOCAL.INI 97 01-10-1997 04:24

SHOW_DIRECTORY_ALL ["filename.ext"]

Responds with the directory entries on the RAM disk or ROM disk directory that match the specified filename. Wildcards are permissible, and if a drive letter is included, **A:** should be used for the ROM disk and **C:** should be used for the RAM disk. If no drive letter is included, **C:** is used. If no filename is included, **C:*.*** is used. This command returns multiple response records until all matching directory entries have been returned.

Responses:

MCBLOCAL.INI 97 01-10-1997 04:24

SHOW_DIRECTORY_NEXT

Responds with the next matching directory entry which matches the filename specified in a SHOW_DIRECTORY command. If there are no more matching entries, a %131137 response is returned.

Execution Errors:

%131137085<CR>	No more matching entries.

SHOW_FEATURES

Responds with four 32-bit masks that indicate which features are present in the MCB. See Section 4.11 for a complete description of each bit in the mask.

Example Response:

FEATURES 02285062207 02014941185 00000000000 00000000000

SHOW_GAIN_ADJUSTMENT

Returns the current gain peak stabilization adjustment as a number from 0 to 4096. This value changes dynamically when gain stabilization is enabled. See Appendix B for more information. See also SET_GAIN_ADJUSTMENT.

Responses:

$C00000087<CR>	Gain adjustment reported as 0 (–.49971%).
$C00001088<CR>	Gain adjustment reported as 1 (–.49947%).
$C02047100<CR>	Gain adjustment reported as 2047 (–.000244%).
$C02048101<CR>	Gain adjustment reported as 2048 (0.0%).
$C02049102<CR>	Gain adjustment reported as 2049 (+.000244%).
$C04094104<CR>	Gain adjustment reported as 4094 (+.49947%).
$C04095105<CR>	Gain adjustment reported as 4095 (+.49971%).

SHOW_GAIN_CHANNEL

Reports the current center channel for the stabilizer gain peak for the MCB. See Appendix B for more information. See also SET_GAIN_CHANNEL.

Responses:

$C00000087<CR>	Gain channel has not been set.
$C00002089<CR>	Gain channel is channel 2 (lowest possible channel).
$C16382107<CR>	Gain channel is channel 16382 (highest possible channel).

SHOW_GAIN_CONVERSION

This command returns the conversion gain for the MCB.

Responses:

$C00512095<CR>	Conversion gain reported as 512 channels.
$C01024094<CR>	Conversion gain reported as 1024 channels.
$C02048101<CR>	Conversion gain reported as 2048 channels.
$C04096106<CR>	Conversion gain reported as 4096 channels.
$C081921E07<CR>	Conversion gain reported as 8192 channels.
$C16384109<CR>	Conversion gain reported as 16384 channels.

SHOW_GAIN_PRESET

Reports the Gauss mode stabilization preset for the gain peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the gain

peak before the gain is evaluated by the stabilizer and potentially adjusted. See Appendix B for more information. See also SET_GAIN_PRESET and CLEAR_PRESETS.

Responses:

$G0000000010076<CR>	Gain preset currently 10 counts (minimum).
$G0000000011076<CR>	Gain preset currently 11 counts.
$G2147483647121<CR>	Gain preset currently 2147483647 counts (maximum).

SHOW_GAIN_STABILIZATION

Reports the state of gain peak stabilization. See Appendix B for more information. See also ENABLE_GAIN_STABILIZATION and DISABLE_GAIN_STABILIZATION.

Responses:

$IT<CR>	Gain stabilization is currently enabled.
$IF<CR>	Gain stabilization is currently disabled.

SHOW_GAIN_WIDTH

Reports the current width for the stabilizer gain peak for the MCB. See Appendix B for more information. See also SET_GAIN_WIDTH, SET_GAIN_CHANNEL, and SHOW_GAIN_CHANNEL.

Responses:

$C00001088<CR>	Gain width has not been set.
$C00003089<CR>	Gain width is 3 channels (lowest possible width).
$C00256100<CR>	Gain width is 256 channels (highest possible width in Gauss mode).
$C16383108<CR>	Gain width is 16383 channels (highest possible width in point mode with gain channel set to 8192).

SHOW_GATE

Reports the current mode of operation of the ADC gate input. See Section 4.2 for more information on the ADC GATE input. See also SET_GATE_OFF, SET_GATE_COINCIDENT, and SET_GATE_ANTICOINCIDENT.

Responses:

$FOFF<CR>	Reports the ADC gate is off or ignored.
$FCOI<CR>	Reports the ADC gate is in coincident mode.
$FANT<CR>	Reports the ADC gate is in anticoincident mode.

SHOW_INPUT [0]

Reports the state of the Sample Ready input. See also PAUSE_INPUT, PAUSE_INPUT_HIGH, and PAUSE_INPUT_LOW.

Responses:

$C00000087<CR>	Sample Ready input is low.
$C00001088<CR>	Sample Ready input is high.

SHOW_INTEGRAL [start_chan,number_of_chans]

Reports the sum of the specified group of spectral data channels for the MCB. If start_chan and number_of_chans is not provided, SHOW_INTEGRAL reports the sum of all channels in the currently selected segment that have their ROI flag set.

Responses:

$G0000000000075<CR>	Integral reported as 0.
$G4294967294131<CR>	Integral reported as 4294967294.
$G4294967295132<CR>	Integral reported as greater than or equal to 4294967295 (maximum reportable value).

SHOW_INTEGRAL_PRESET

Reports the current ROI integral preset value for the MCB. See SET_INTEGRAL_PRESET for more information about the ROI integral preset. See also SHOW_INTEGRAL.

Responses:

$G0000000000075<CR>	Integral preset reported as 0.
$G4294967295132<CR>	Integral reported as 4294967295.

SHOW_INTEGRAL_REMAINING

Reports the current ROI integral remaining value. For more information about the ROI integral remaining, see SET_INTEGRAL_REMAINING. See also SHOW_INTEGRAL.

Responses:

$G0000000000075<CR>	Integral remaining reported as 0.
...	...
$G4294967295132<CR>	Integral reported as 4294967295.

SHOW_LIVE

Reports the contents of the live-time counter for the MCB in units of 20 ms (50 ticks per second). See also CLEAR_COUNTERS and SET_LIVE.

Responses:

$G0000000000075<CR>	Live time reported as 0 ticks.
$G0000000001076<CR>	Live time reported as 1 tick (20 ms).
$G4294967295132<CR>	Live time reported as 4294967295 ticks.

SHOW_LIVE_PRESET

Reports the current live-time preset for the MCB in units of 20 ms (50 ticks per second). See also CLEAR_PRESETS and SET_LIVE_PRESET.

Responses:

$G0000000000075<CR>	Live-time preset reported as disabled.
$G0000000001076<CR>	Live-time preset reported as 1 tick.
$G4294967295132<CR>	Live-time preset reported as 4294967295 ticks.

SHOW_LIVE_REMAINING

Reports the current live-time remaining in units of 20 ms (50 ticks per second). See also SET_LIVE_REMAINING.

Responses:

$G0000000000075<CR>	Live time remaining reported as disabled.
$G0000000001076<CR>	Live time remaining reported as 1 tick.
...	...
$G4294967295132<CR>	Live time remaining reported as 4294967295 ticks.

SHOW_MDA

Returns the uncorrected MDA in gammas/s by calculating the right half of the MDA equation (see SET_MDA_COEF) and returns that value.

Example Responses:

MDA 000000000000.85	MDA = 0.85.

SHOW_MDA_COEFFICIENTS

Returns the coeffficients used for the MDA calculation. See SET_MDA_COEFFICIENTS.

Example Responses:

MDA_COEF 000000000002.71 000000000000000 0000000000021.7

Coefficient a = 2.71, b = 0, and c = 21.7.

SHOW_MDA_PRESET

Returns the current MDA preset setting.

Example Responses:

MDA 000000000000000	No preset.
MDA 0000000000008.5	Preset set to 8.5%.

SHOW_MODE

This command is for compatibility with Model 918 systems. It always reports that the 921E operates in PHA mode.

Responses:

$FPHA<CR>

SHOW_MODE_STAB

Reports the current stabilization mode of operation. See Appendix B for more information. See also SET_MODE_POINT and SET_MODE_GAUSS.

Responses:

$FPOINT<CR>

$FGAUSS<CR>

SHOW_NETWORK_ADDRESS

Returns in a $H record the Ethernet address used by the 83905 Ethernet chip. The address is composed of a 32-bit company portion of the address which is usually set to the ORTEC ID (41020) followed by the address portion. See also SET_NETWORK_ADDRESS.

Responses:

$H0000041020000000000016058 Company ID=41020, Address=16

SHOW_NETWORK_ID

Responds with a $F record indicating the network identifier which will be used by the MCB for all network communication. The default host name is 921-xxxx, where xxxx is the serial number of the MCB. See also SET_NETWORK_ID.

Responses:

$F921-0100

SHOW_NEXT

Used in conjunction with the SHOW_ROI command, SHOW_NEXT reports the next continuous group of channels in the MCB that have the ROI flag set. The response is of the form:

$Dsssssnnnnnccc<CR>

where sssss represents an integer number that is the number of the first channel of the "next" group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. If no more channels have their ROI bit set, SHOW_NEXT returns a first channel of 0 and a number of channels of 0. The SHOW_ROI command is used to report the "first" group of channels that all have their ROI bit set.

Example Responses:

$D0100000050078<CR>	Next ROI group starts at chan 1000 and is 50 channels long.
$D0215000150086<CR>	Next ROI group starts at chan 2150 and is 150 channels long.
$D0000000000072<CR>	No other ROI groups to report.

SHOW_OUTPUT [0]

Reports the status of the "Change Sample" output port. The output port status is reported as a 16-bit number that is either 0 or 1, depending on the level last set by a SET_OUTPUT_HIGH or SET_OUTPUT_LOW command.

Responses:

$C00000087<CR>	Change Sample output currently at a low level.
$C00001088<CR>	Change Sample output currently at a high level.

SHOW_OVERFLOW_PRESET

Reports the state of the overflow preset for the MCB.

Responses:

$IT<CR>	Overflow preset enabled for the MCB.
$IF<CR>	Overflow preset disabled for the MCB.

SHOW_PAGE

See also SET_PAGE.

Responses:

$A001246	Page Number 1.

SHOW_PEAK

This command returns the contents of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The maximum possible value is 2147483647, which is the maximum number of counts that can be stored in a 31-bit channel.

Responses:

$G0000000000075<CR>	Maximum count in an ROI channel is zero or no ROI channels were found.
$G0000000001076<CR>	Maximum count in an ROI channel is 1.
$G2147483646120<CR>	Maximum count in an ROI channel is 2147483646.
$G2147483647121<CR>	Maximum count in an ROI channel is 2147483647.

SHOW_PEAK_CHANNEL

This command returns the number of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The lowest number ROI channel with the largest count is reported if more that one channel contains the largest number of counts. Channel 16383 is the highest numbered channel in the MCB.

Responses:

$C00000087<CR>	Maximum count was found in channel 0 or no ROI channels were found (see errors below).
$C00001088<CR>	Maximum count was found in channel 1.
$C16382107<CR>	Maximum count was found in channel 16382.
$C16383108<CR>	Maximum count was found in channel 16383.

SHOW_PEAK_PRESET

Reports the value of the ROI peak preset for the MCB. See SET_PEAK_PRESET for information about the ROI peak preset.

Responses:

$G0000000000075<CR>	Peak preset disabled.
$G0000000001076<CR>	Peak preset set to 1 count.
$G2147483646120<CR>	Peak preset set to 2147483646 counts.
$G2147483647121<CR>	Peak preset set to 2147483647 counts.

SHOW_RADIX

This command is for compatibility with other ORTEC MCBs. It always reports that the number base radix for the WRITE command is binary.

Responses:

$FBIN<CR>	Number base set to binary radix.

SHOW_REMOTE

See also SET_REMOTE.

Responses:

$IT<CR>	The remote is enabled.
$IF<CR>	The remote is disabled.

SHOW_ROI

Used in conjunction with the SHOW_NEXT command, SHOW_ROI reports the first continuous group of channels in the MCB that have the ROI flag set. The response is of the form:

$Dsssssnnnnnccc<CR>

where sssss represents an integer number that is the number of the first channel of the "first" group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. The SHOW_NEXT command is used to report the "next" group of channels that all have their ROI bit set.

Responses:

$D0100000050078<CR>	First ROI group starts at channel 1000 and is 50 channels long.
$D0215000150086<CR>	First ROI group starts at channel 2150 and is 150 channels long.
$D0000000000072<CR>	No ROI groups to report.

SHOW_ROI_MDA

Reports the start channel and number of channels used in the MDA preset calculation.

Example Response:

$D0700000050ccc	Calculation is performed on channels 7000–7049.

SHOW_ROI_UNCERTAINTY

Reports the start channel and number of channels used in the uncertainty preset calculation. See also SET_ROI_UNCERTAINTY.

Response:

$D0700000050ccc	Calculation is performed on channels 7000–7049.

SHOW_SEGMENT

This command is for compatibility with other ORTEC MCBs. It reports the last value that was set with the SET_SEGMENT command. Segments have no meaning in 921E MCBs.

Responses:

$A001246<CR>	Segment last set to 1.
$A002247<CR>	Segment last set to 2.
$A016252<CR>	Segment last set to 16.

SHOW_SNUM

Responds with a $F record indicating the serial number of the MCB. See SET_SNUM.

Responses:

$F100	Serial Number = 100.

SHOW_STATUS

Returns system status information in the following format:

$Mlllllllllltttttttttaaaaahhhhhccc<CR>

where lllllllll represents the live time as returned by the SHOW_LIVE command, ttttttttt represents the true time for the MCB as returned by the SHOW_TRUE command, aaaaa represents the active device mask as returned by the SHOW_ACTIVE_DEVICES command, and hhhhh represents the hardware status, which is an ASCII representation of a 16-bit decimal number with the following bit definitions:

Bit 0 (LSB):	Bias Supply Polarity (0=positive, 1=negative).
Bit 1:	Bias Supply Overload (0=overload, 1=normal).
Bit 2:	High Voltage Enabled (0=disabled, 1=enabled).
Bit 3:	Unused.
Bit 4:	Amplifier pole-zeroed since initialization. (0=normal, 1=needs pole zeroing).
Bits 5–7:	Unused.
Bit 8:	Amplifier Automatic Pole Zero (1 = Auto Pole Zero in progress, 0 = normal).
Bits 9–14:	Unused.
Bit 15 (MSB):	Reserved.

SHOW_TIME

Reports the time from the battery backed-up system clock in the form:

$Nhhhmmmssscccc<CR> where hhh represents a 3-digit integer hour (0 through 23), mmm represents a 3-digit integer minute (0 through 59), and sss represents a 3-digit integer second (0 through 59). See also SET_TIME, SET_DATE, and SHOW_DATE.

Example Responses:

$N010054017052<CR>	Time returned 10:54:17 (10 hours, 54 min, 17 sec).
$N020013037050<CR>	Time returned 20:13:37 (20 hours, 13 min, 37 sec).

SHOW_TIME_START

Reports the time of the last START command for the MCB in the form: **$Nhhhmmmssscc<CR>** where hhh represents a 3-digit integer hour (0 through 23), mmm represents a 3-digit integer minute (0 through 59), and sss represents a 3-digit integer second (0 through 59). See also SET_TIME_START, SET_DATE_START, and SHOW_DATE_START.

Example Responses:

$N010054017052<CR>	Time returned 10:54:17 (10 hours, 54 min, 17 sec).
$N020013037050<CR>	Time returned 20:13:37 (20 hours, 13 min, 37 sec).

SHOW_TIME_TRIGGER

Responds with the time that the last valid trigger occurred either via the TRIGGER command or the Sample Ready input. If no valid trigger has occurred since power-up or if ENABLE_TRIGGER is sent followed by DISABLE_TRIGGER without a valid trigger, the command returns all zeros.

Example Responses:

$N000000000ccc<CR>	No valid triggers have occurred.
$N013011012ccc<CR>	Trigger occurred at 1:11:12 p.m.

SHOW_TRIGGER

Reports if the trigger is enabled or disabled. See also ENABLE_TRIGGER and DISABLE_TRIGGER.

Responses:

$IF<CR>	Trigger disabled.
$IT<CR>	Trigger enabled.

SHOW_TRUE

Reports the contents of the true-time counter for the MCB in units of 20 ms (50 ticks per second). See also CLEAR_COUNTERS and SET_TRUE.

Responses:

$G0000000000075<CR>	True time reported as 0 ticks.
$G0000000001076<CR>	True time reported as 1 tick (20 ms).
$G4294967295132<CR>	True time reported as 4294967295 ticks (over 23,000 days).

SHOW_TRUE_PRESET

Reports the current true-time preset for the MCB in units of 20 ms (50 ticks per second). See also CLEAR_PRESETS and SET_TRUE_PRESET.

Responses:

$G0000000000075<CR>	True-time preset reported as disabled.
$G0000000001076<CR>	True-time preset reported as 1 tick.
$G4294967295132<CR>	True-time preset reported as 4294967295 ticks.

SHOW_TRUE_REMAINING

Reports the current true time remaining in units of 20 ms (50 ticks per second). See also SET_TRUE_REMAINING.

Responses:

$G0000000000075<CR>	True time remaining reported as disabled.
$G0000000001076<CR>	True time remaining reported as 1 tick.
...	...
$G4294967295132<CR>	True time remaining reported as 4294967295 ticks.

SHOW_UNCERTAINTY

Returns the current value of the uncertainty for the peak in the uncertainty preset. See also SET_UNCERTAINTY.

Responses:

UNCE 0000000000008.5	Uncertainty of the peak is 8.5%

SHOW_UNCERTAINTY_PRESET

Returns the current uncertainty preset setting. See also SET_UNCERTAINTY_PRESET.

Responses:

UNCE_PRES 000000000000000	No preset.
UNCE_PRES 0000000000008.5	Preset set to 8.5%.

SHOW_VERSION

Reports the 921E firmware version number in the form:

Fmmmm-vvv<CR>

where mmmm is a 4-character model designator and vvv is a 3-character version designator.

Example Responses:

$FE921-005<CR>	Model 921E firmware version 5 reported.

SHOW_WIDTH

Reports the maximum number of bytes that can be sent by the 921E to the host computer as a result of the WRITE command. See also SET_WIDTH and WRITE.

Responses:

$C00012090<CR>	Width reported as 12 bytes (minimum width).
$C00013091<CR>	Width reported as 13 bytes.
$C00512095<CR>	Width reported as 512 bytes (maximum width).

SHOW_WINDOW

Reports the start channel and number of channels that are in the window of interest for the MCB in the form:

$Dxxxxxyyyyyccc<CR>

where xxxxx is the start channel (0 through 16383) and yyyyy is the number of channels (1 through 16384). See SET_WINDOW for more information about the window of interest.

Example Responses:

$D0000016384094<CR>	Window of interest reported as starting at channel 0 and continuing for 16384 channels.
$D0000008192092<CR>	Window of interest reported as starting at channel 0 and continuing for 8192 channels (first 1/2).
$D08192081921E12<CR>	Window of interest reported as starting at channel 8192 and continuing for 8192 channels (last 1/2).

SHOW_ZERO_ADJUSTMENT

Returns the current zero peak stabilization adjustment as a number from 0 to 4095. This value changes dynamically when zero stabilization is enabled. See Appendix B for more information. See also SET_ZERO_ADJUSTMENT and INITIALIZE_ZERO_STABILIZATION.

Responses:

$C00000087<CR>	Zero adjust reported 0 or −50.00 mV.
$C00001088<CR>	Zero adjust reported 1 or −49.98 mV.
$C02047100<CR>	Zero adjust reported 2047 or −0.024 mV.
$C02048101<CR>	Zero adjust reported 2048 or 0.0 mV.
$C02049102<CR>	Zero adjust reported 2049 or 0.024 mV.
$C04094104<CR>	Zero adjust reported 4094 or 49.98 mV.
$C04095105<CR>	Zero adjust reported 4095 or 50.00 mV.

SHOW_ZERO_CHANNEL

Reports the center channel for the stabilizer zero peak for the MCB. See Appendix B for more information. See also SET_ZERO_CHANNEL, SET_ZERO_WIDTH and SHOW_ZERO_WIDTH.

Responses:

$C00000087<CR>	Zero channel has not been set.
$C00002089<CR>	Zero channel is channel 2 (lowest possible channel).
$C16382107<CR>	Zero channel is channel 16382 (highest possible channel).

SHOW_ZERO_PRESET

Reports the Gauss mode stabilization preset for the zero peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the zero peak before the zero offset is evaluated by the stabilizer and potentially adjusted. See Appendix B for more information. See also SET_ZERO_PRESET and CLEAR_PRESETS.

Responses:

$G0000000010076<CR>	Zero preset currently 10 counts (minimum).
$G0000000011076<CR>	Zero preset currently 11 counts.
$G2147483647121<CR>	Zero preset currently 2147483647 counts (maximum).

SHOW_ZERO_STABILIZATION

Reports the state of zero peak stabilization. See Appendix B for more information. See also ENABLE_ZERO_STABILIZATION and DISABLE_ZERO_STABILIZATION.

Responses:

$IT<CR>	Zero stabilization is currently enabled.
$IF<CR>	Zero stabilization is currently disabled.

SHOW_ZERO_WIDTH

Reports the current width for the stabilizer zero peak for the MCB. See Appendix B for more information. See also SET_ZERO_WIDTH, SET_ZERO_CHANNEL, and SHOW_ZERO_CHANNEL.

Responses:

$C00001088<CR>	Zero width has not been set.
$C00003089<CR>	Zero width is 3 channels (lowest possible width).
$C00256100<CR>	Zero width is 256 channels (highest possible width in Gauss mode).
$C16383108<CR>	Zero width is 16383 channels (highest possible width in point mode with zero channel set to 8192).

START [seg-mask]

Starts the acquisition of spectral data in the MCB. The optional segment mask is provided for compatibility with other MCBs and can be any value from 0 to 65535, but is ignored by the Model 921E.

Execution Warnings:

%000005074<CR>	The acquisition is already started (no changes made).
%000006075<CR>	A preset was exceeded (acquisition was not started).

STEP_OUTPUT [0]

Causes a pulse to be output on the Change Sample output port. The level of the Change Sample output is changed then returned to the level present when the STEP_OUTPUT command is received. The duration of the intermediate level varies but is never less than 2 µs. Use the SET_OUTPUT_HIGH or SET_OUTPUT_LOW commands to establish an initial output level.

Responses:

$C00000087<CR>	The initial and final level on Change Sample was low.
$C00001088<CR>	The initial and final level on Change Sample was high.

STOP [seg-mask]

Stops the acquisition of spectral data in the MCB. The optional segment mask is provided for compatibility with other MCBs and can be any value from 0 to 65535, but is ignored by the Model 921E.

Execution Warnings:

%000005074	Acquisition already stopped (no changes made).

TERMINAL

Prepares the serial line for communication with a terminal. In terminal mode, text sent to the 921E echoes back to the host and response records sent to the host by the 921E are terminated with a carriage return and line feed. This command has no effect when sent via the mailbox. See also COMPUTER.

TEST mask

Performs any combination of the 921E internal selftests where mask represents a 16 bit integer with each bit set specifying a test as follows:

Bit 0 (LSB):	ROM checksum test (nondestructive).
Bit 1:	Spectral data memory test (destroys spectral data).
Bit 2:	Processor memory test (destroys spectral data).
Bit 3:	Serial line test (serial loop-back connector required).
Bit 4:	RESERVED.
Bit 5:	Mailbox memory test (may cause mailbox comm error).

Execution Errors:

%004002075<CR>	ROM1 failed test.
%004004077<CR>	ROM2 failed test.
%004008081<CR>	Processor Memory failed test.
%004016080<CR>	Spectral Data Memory or Mailbox Memory failed test.
%004032078<CR>	RESERVED.
%004064083<CR>	Serial Line failed test.

The actual response record can be a combination of any of the above records depending on the selftests performed. For example:

%004006079<CR> ROM1 and ROM2 both failed test.
%004010074<CR> Processor Memory and ROM1 both failed test.

TRIGGER

Triggers the data acquisition as if an edge occurs on the Change Sample connector. See ENABLE_TRIGGER and DISABLE_TRIGGER.

WRITE

Starts the transmission of the spectral data in the window of interest (see SET_WINDOW command) for the MCB from the 921E to the host computer. The WRITE command responds with a binary data record as follows:

#Bllcc?111122223333 ... nnnns

In this record ll represents a 16-bit binary integer that is the record length, cc represents a 16-bit binary integer that is the number of the first channel in the record, ? is an unused byte, 1111 represents a 32-bit binary integer that is the contents of the first channel in the record, 2222 represents the second channel in the record, etc., nnnn represents the nth channel in the record, and s represents an 8-bit binary checksum of the entire record up to the checksum byte itself.

After the 921E MCB responds with a binary data record, the host computer must prompt for the next record with one of the following handshake prompts: GO<CR>, RE<CR>, or HA<CR>. GO causes the next binary data record to be sent by the 921E or the % response if the last record has already been sent. RE causes the previous binary data record to be resent exactly as it was the last time. HA causes the WRITE command to be halted and responds with a %130131078<CR> record.

The number of channels that are sent on a binary data record depends on the record width as set by the SET_WIDTH command and the number of channels remaining in the window of interest to be sent. If the record is the last record to be sent, it will contain the number of channels remaining in the window of interest. This may or may not be the same number of channels as the previous record(s). If the record is not the last record to be sent, it will contain as many channels as will fit without creating a binary data record that is longer than the limit set by the SET_WIDTH command. The following formula can be used to determine the number of channels that will be sent on a record that isn't the last record:

$$CHANS = (WIDTH - 8) / 4$$

In the above formula CHANS is the integer number of channels that will be sent on the record and WIDTH is the current record width as set by the SET_WIDTH command (maximum value is 512 bytes).

WRITE_FILE "aabbccddeeff"

Writes a block of data to the file which was opened with the OPEN_FILE command. Each byte of data is encoded as a two hexadecimal character. In the example above, 5 bytes are sent. Multiple WRITE_FILE commands can be used to send a long file to the MCB.

WRITE_FILE_FLASH "aabbccddeeff"

Writes a block of data to be written to the flash memory beginning with the first byte in the flash memory. The OPEN_FILE_FLASH command must be set before using this command. Each byte of data is encoded as two hexadecimal characters. In the example above, 5 bytes are sent. Multiple WRITE_FILE_FLASH commands are used to send the entire block of data.

APPENDIX B. DIGITAL SPECTRUM STABILIZATION

The purpose of digital spectrum stabilization is to reduce the effects of peak drift on a spectroscopy system. A digital spectrum stabilizer serves as a feedback element in a spectroscopy system. The location of a peak (channel number) is given to the spectrum stabilizer. The stabilizer then starts "watching" the output of the ADC. If the stabilizer detects a drift in the system, the gain and/or offset of the amplifier output is adjusted to keep the peak at the desired channel.

Two algorithms are provided in the Model 921E. The first is the well known method used in most stabilizers where the gain and/or offset of the amplifier is adjusted by a small amount after each data point. This algorithm is referred to as *Point Mode* in this document. The second algorithm consists of collecting a set amount of data and fitting a Gaussian to the data to determine if any peak shift has occurred and to correct for it.

B.1. Point Mode Stabilization

In Point Mode the gain and/or offset of the unit is changed on every data point that falls within the window of interest. The basic setup algorithm is as follows:

When gain conversion is active, the user selects a peak to stabilize on. The highest energy peak in the spectrum is generally chosen as gain shifts are more prominent on higher energy peaks. Next, the width of the window to stabilize on is selected. The width should be chosen large enough so that there is little chance that the peak will get shifted out of the window by a sudden peak shift. However, it should be chosen small enough that only a single peak is in the window. Now the ADC and stabilizer can be started. The Model 921E intercepts ADC conversions and compares them to the window selected earlier. If the conversion falls outside the window, no corrections are made. If the conversion falls in the high half of the window, the gain of the stabilizer is decreased by a small amount. If the conversion falls in the low half of the window, the gain of the stabilizer is increased by a small amount.

Zero correction is very similar to gain correction except the peak of interest is generally the lowest energy peak in the spectrum. At low energies the gain adjustments have little effect on the peak location, so the adjustments made by the gain corrections have little effect on the zero corrections.

B.2. Gauss Mode Correction

In Gauss Mode, data is collected in the Model 921E until a peak preset expires. When the preset expires, the microprocessor in the Model 921E fits a Gaussian to the data to determine the

centroid of the peak. This information is then used to determine how much, if any the gain and/or offset must be adjusted to keep the gain and/or zero peaks in their nominal position. When in Gauss Mode, setup is very similar to Point Mode except a few more pieces of information are required. The information required are the peak presets for the gain and zero peak. These values specify the value which any channel in the window must reach before a correction is made.